

DOCUMENT RESUME

ED 174 395

SE 026 328

AUTHOR Stroup, Kala; Jasnoski, M. L.
 TITLE Do Talented Women Fear Math?
 SPONS AGENCY American Association of Univ. Women, Washington, D.C.
 PUB DATE 77
 NOTE 10p.; Not available in hard copy due to marginal legibility of original document
 EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
 DESCRIPTORS *Anxiety; *Career Opportunities; *College Mathematics; Higher Education; *Research; Sex Differences; *Talented Students; *Womens Education
 IDENTIFIERS *Research Reports

ABSTRACT

Talented women were defined as college freshmen or sophomores having at least three years of high school mathematics and a mathematics ACT score of 27 or higher. The proposition that math anxiety would result in math avoidance when these talented women entered college was studied. The conclusion was that these talented women are generally not avoiding math because they are anxious. Possible explanations are given and suggestions for further research are made. (MP)

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Do Talented Women Fear Math?

Kala Stroup and M. L. Jasnoski
University of Kansas

This project has been supported by the AAUW Research Foundation

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Boys generally out-perform girls in mathematics--but only after the sixth grade (Suydam & Riedesel, 1969). Before then girls' and boys' attitudes toward and performances in all subjects, including mathematics, are comparable (Levine, 1976). During elementary school each gender believes their own out-performs the other gender 'a all subjects. In reality, their performances are fairly equal. At the onset of adolescence girls' belief regarding mathematics performance begins to change; they now think boys perform mathematical tasks better than they do. Concurrently, the trend toward a gender differential favoring boys appears in math performance. By the ninth grade, boys out-perform girls at a statistically significant level.

In searching for an explanation to this gender by age interaction, two facts are important to remember. One, the gender differential does not apply to general reasoning ability. Girls perform equally as well as boys on verbal syllogisms, but not on numerical syllogisms (Maccoby, 1972). Numbers, or mathematics, appears to be the focus of the gender differential. Second, the gender differential appears with age and therefore may not be an innate difference, but a culturally induced one (Aiken, 1971). One possible argument for it as an innate difference is that different skills, such as spatial relations, are needed to learn the advanced math concepts introduced after sixth grade. Boys do have better spatial relations skills than girls--but, again, only after sixth grade (Maccoby, 1972). The question still remains--what happens in the sixth grade? Many retrospective studies suggest that the onset of puberty may provide the answer.

At the onset of puberty the young girl begins her metamorphosis into an adult woman. Physiological processes make gender distinctions more salient. The cultural imperative for sex-role appropriate behavior, or feminine behavior, now becomes more stringently demanded of young girls. "Tomboy" behavior becomes less tolerated and sex role conformity becomes more desired and rewarded. In becoming a woman, feminine success is measured in social terms, particularly, popularity. In becoming an adult, personal success is measured in terms of achievements and performing to the very best of one's ability. Academic achievement is an important barometer of future adult success in our culture. But academic accomplishments do not necessarily enhance, and often detract from a girl's popularity (Beck, 1977). Being personally successful can threaten being femininely successful. Achievement in mathematics, in particular, seems peripheral to a girl's popularity, and may even stigmatize her as socially incompetent or less feminine because she has a masculine mind. A popular cultural myth is that only masculine minds can understand math (Ernest, 1976). For adolescent boys the adult role is congruent with the masculine role. Often masculinity is defined in terms of achievements, such as math performance. But girls often must choose between succeeding either as valued women or as valued adults (Droverman et. al., 1972). Personal achievement in areas such as mathematics clashes with

popularity and femininity in what has been termed a battleground for adolescent girls (Schaefer, 1977). The widening gender gap in math achievement indicates that math is losing this battle.

Girls may begin to avoid mathematics as a way of managing this clash between popularity and performance. This math avoidance is thought to be a symptom of math anxiety (Tobias, 1976). When math becomes optional in high school and college girls take fewer math courses, or drop out totally. (Ernest, 1976). This situation can result in atrophy of girls' math skills. Their performance then falls behind those students, mostly boys, who have continued their math study. The fear of failure found in math anxiety becomes a realistic concern of these girls. Intervention programs for them at the college level would require a double-barreled program aimed at remediation in math as well as management of the anxiety.

But what of the girls who remain in mathematics to complete the college-bound tract in high school? Mathematics anxiety in these girls would not be confounded by their realistic deficit in math skills. Entering college they would have mathematical skills comparable to most males, and be able to enroll directly in the calculus sequence. The calculus sequence has been found to be the critical filter for entrance into nontraditional careers for women, such as science or engineering. These freshmen women who are prepared to enter the calculus sequence would be the prime candidates for non-traditional careers, but even these women do not reach such fields where a high degree of mathematics competency is required. When mathematics is no longer necessary for their goals, i.e., entering college, these girls opt out of mathematics just as many other girls did in adolescence. We hypothesized that math anxiety might be a barrier these talented women faced in college rather than adolescence. Fears, such as math anxiety, seem to be exacerbated when a woman is in her terminal schooling, which college would be for most of these talented women (Tobias and Donady, 1977).

To study the proposition that math anxiety would result in math avoidance when these talented women entered college we undertook a two-phased project. Talented women were defined as freshmen and sophomores having at least three years of high school mathematics, and a mathematics ACT score of 27 or higher. Phase I of our project consisted of assessing self-reported math anxiety in a group of women who attended a workshop on Science Careers and Women. Phase II entailed surveying those women who did not attend the workshop. We thought different career orientations between the two groups might be indicative of different, distinct population samples. The sample in Phase I would be women already motivated enough toward a non-traditional career to attend a workshop. Phase II's sample would consist of those women more oriented toward a traditional career. Analysis of the data confirmed these

group differences in career orientation.

The data on math anxiety reported in both phases has led to consideration of plausible rival hypotheses regarding math avoidance in a group of talented women.

Phase I

All talented women who were freshmen and sophomores at the University of Kansas received special invitations to participate in a workshop on Science Careers and Women. At this workshop we conducted a survey of the math anxiety of the women who attended. The survey consisted of a mathematics interest questionnaire and a questionnaire measuring mathematics anxiety. In a 1976 study, Levine created and validated these questionnaires on a population of sophomore women. Reliability coefficients were .919 for the interest questionnaire and .870 for the anxiety questionnaire.

We also included two additional questions on how mathematics influenced the subjects' college study or career plans, and a request to list the college mathematics courses they had taken or were currently taking. Forty of the forty-three workshop participants responded to our questionnaires.

Results

The survey data were analyzed using three factors, i.e., Anxiety, Interest, and Courses. An anxiety index and an interest index were derived from the appropriate questionnaires, Scale values ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). The course factor corresponded to number of math courses taken or currently taking in college.

	<u>Anxiety</u>	<u>Interest</u>	<u>Courses</u>
Mean	2.48	3.38	1.45
Standard Deviation	.65	.74	1.15

The women's self-reported anxiety level was not significantly different from an average level, but their interest level was significantly higher than average. An average level indicates the scale point described as undecided.

Relationships between the factors were determined by the Pearson Product Moment Correlation Method. All correlations were non-significant.

	<u>r-value</u>	<u>p-value</u>
ANXIETY x INTEREST	-.27	.10
ANXIETY x COURSES	-.41	.10
INTEREST x COURSES	-.26	.10

Respondents felt mathematics had a limited effect on their career choices, Mean = 1.38, scale range = 1 (not at all) to 3 (very influential). The mathematics study most planned to pursue in college was only general and major departmental requirements, Mean = 1.63, scale range = 1 (courses of my own interest beyond requirements) to 3 (only basic general requirements).

Discussion and Conclusions

As a group, talented women interested in science careers report average mathematics anxiety and higher than average mathematics interest. In regard to math anxiety, these talented women who are interested enough in a science career to attend a workshop may be a very specialized sample of the population of all talented women at the University of Kansas. Since entrance into a scientific profession requires high mathematics achievement in high school and college, only women who are not math anxious may still be seriously considering science as a career option for them. Talented women who are math anxious may not be included in our sample. Interpretation of this data should then be qualified as applying to talented college women who want to pursue a science career.

The courses factor may be confounded by the fact that our target group consisted of freshmen and sophomores. The number of courses they list may be an artifact of their limited opportunities to take mathematics courses rather than either lack of interest or presence of math anxiety. When they are seniors, a measure of their mathematics enrollment throughout college should give a more accurate reflection of their mathematics interest or anxiety.

Although not significant, the relationship between Anxiety x Interest was inverse. Lower anxiety corresponded with high interest. Even in this special subset of talented women, those with higher math anxiety had a lower level of interest in math.

Phase II

Phase II was initiated to find out if these talented women who are interested in a science career were representative of all talented women at K.U. in regard to level of mathematics anxiety.

Only thirty-one percent of these women will pursue mathematics courses of their own interest. Fifty-one percent will pursue only major and general requirements. Of these 51 percent, twenty-eight percent were influenced in their choice of career and major by mathematics requirements. A total of eighty-three women (67%) are arranging to take the very minimum amount of mathematic courses.

Underenrollment happens when a woman enrolls in a course below the level for which she is qualified. According to their list of math courses they have taken in college and high school and their ACT scores, when these women do take math courses, they underenroll. Nineteen women in this group of one hundred twenty-four enrolled in courses that added credit hours and grade points to their graduation requirements! This unobtrusive measure, and the findings above lend support to the contention that math avoidance exists in this group of talented women, even if mathematics anxiety does not.

Discussion and Conclusions

These talented women we studied are generally not avoiding math because they are anxious. They do not fear failure in math, an important aspect of mathematics anxiety. (Tobias, 1976). Something else besides math anxiety is causing a trend toward math avoidance and underenrollment early in their college careers. A follow-up study later in their academic careers could answer the question whether this avoidance will result in greater mathematics anxiety in this population. For these women, math anxiety may be a symptom of math avoidance and not vice versa.

Whether this causal turnabout may happen also in adolescence awaits direct study of the young girls' subjective experiences with mathematics. A need exists to document this subjective emotional aspect just as we have documented the objective, cognitive aspect of mathematical achievement in adolescence. As it is now, only retrospective data supports the theoretical basis for the current popular proposition that math avoidance is a symptom of math anxiety (for example see Schaefer, 1977). Such data may be confounded by the demand characteristics of the interview setting as well as the respondents' present experience. Current math anxiety may be introjected into memories of earlier math experiences. Until studies occur during adolescence the causal sequence between math anxiety and math avoidance during that time will remain a question. In our college population of talented women, though, math anxiety does not precede math avoidance.

What causes their math avoidance? Preliminary inquiry into this question has indicated several plausible explanations. One may be a fear of success, or a fear of the negative consequences of achievement. Talented women may avoid math because they fear what their success may cost them and not because of their fear

To check this hypothesis, a survey, measuring math anxiety and background data, was sent to the talented women who did not participate in the science careers workshop. This survey, created by Lorelei Brush at Wesleyan University, contrasted mathematics anxiety with humanities anxiety. One hundred twenty-four talented women replied. Only nine respondents reported mathematics anxiety. (Interestingly, sixty-two reported humanities anxiety.)

Year in college and high school background did not differentiate those who were anxious from those who were not. College freshmen who were anxious numbered five; sophomores numbered four. Of the nineteen who ended their high school mathematics study with Algebra II, three were math anxious. Four women out of forty-six who completed trigonometry reported math anxiety. Fifty-nine women finished calculus in high school; two were math anxious.

Math anxiety may not be reported by a substantial number of these talented women, but their enrollment patterns show a trend toward math avoidance. Less than half of these talented women completed calculus in high school. In college their proposed study of mathematics also indicated this trend (See Table A).

TABLE A

Proposed Math Study in College

High School Level Completed	No Math Courses	Only General Req.	Only Major & General Req.	Courses of Interest
Algebra II	1 (1%)	3 (2%)	8 (6%)	6 (5%)
Trigonometry	---	7 (6%)	26 (21%)	13 (10%)
Calculus*	1 (1%)	8 (6%)	29 (23%)	20 (16%)
Totals	2 (2%)	18 (14%)	63 (51%)	39 (31%)

*Two women on this level did not answer the question. N=124

of failure, which is cited as an important aspect of math anxiety (Tobias, 1976). Research in progress awaits completion before this proposition regarding a motive to avoid success becomes more than speculation.

The findings of our current research reported here have important implications for counselors and intervention programs. First, preparation and skills are important sorting mechanisms to distinguish those women who would benefit from the double barreled programs in math anxiety mentioned earlier in this article. Women with good skills and preparation need another kind of intervention to increase or maintain their participation in mathematics. Second, math avoidance exists among talented women in college. The importance of continued math achievement needs to be emphasized in order to promote women's entrance into non-traditional fields which require a high level of mathematics competency. Third, not all the facts are in regarding math anxiety, math avoidance and women. This is a complex problem that needs further study. A danger exists in jumping on a convenient bandwagon such as math anxiety. Generalized intervention programs designed under such simple, premature conclusions are doomed at least to partial failure. Some groups of women are just not math anxious!

REFERENCES

- Aiken, L. Intellectual variables and mathematics achievement: directions for research. Journal of School Psychology, 1971, 9, p. 201-212.
- Beck, J. Sexist Math: Why Women don't count in the classroom. Monitor, March/April, 1977.
- Broverman, I.K., et al. Sex role stereotypes and clinical judgements on mental health. In Readings on the Psychology of Women, J.M. Bardwick (ed.) N.Y.: Harper and Row, Publishers, 1972, p. 320-324.
- Ernest, J., et. al. "Mathematics and Sex" Santa Barbara: University of California, 1976. Printed and distributed by the Ford Foundation.
- Levine, M. Identification of reasons why qualified women do not pursue mathematical careers. Final Report, Project No. GY-11411, August, 1976, National Science Foundation.
- Maccoby, E.E. Sex differences in intellectual functioning In Readings on the Psychology of Women, J.M. Bardwick (ed). N.Y.: Harper and Row, Publishers, 1972, p. 34-44.
- Schaefer, A.T. Wellesley College-Wesleyan University Mathematics Project - Interim Report. March 1977. Fund for Improvement of Postsecondary Education.
- Sells, L. High School Mathematics as the critical filter in the job market. Proceedings of the Conference on Minority Education at the University of California, Berkeley, May 1973.
- Suydam, M.N. and Riedesel, C.A., 1969. Interpretive study of research and development in elementary school mathematics. Vol. I. Introduction and summary: What Research Says. Final Report, Project No. 8-0586, 1969, Department of Health, Education, and Welfare.
- Tobias, S. Math Anxiety: Why is a smart girl like you counting on your fingers? Ms. Magazine, September, 1976, p. 56-59, 92.
- Tobias, S. and Donady, B. Counseling the Math Anxious. Journal of the National Association for Women Deans, Administrators and Counselors. Fall, 1977, Vol. 41, No. 1, p. 13-16.